



## **CAUSE AND IMPACTS OF FOREST FIRE IN HIMACHAL PRADESH**

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### **ABSTRACT**

Himachal Pradesh, nestled in the north-western Himalayas, literally means the 'land of snowy mountains'. The extensive and diverse forests in the State endow the landscape with immense natural beauty. The forests also perform very important ecological function of recharging the aquifers ensuring regular flow of water in the Yamuna, Sutlej, Beas, Ravi and Chenab river systems. The forests of Himachal Pradesh, in addition to their crucial role in environmental and ecological functions in the State and outside, provide for economic well-being of the local communities through various provisioning services. Continuous flow of environmental, ecological and economic services, thus, requires maintaining the integrity of the landscape.

The forests of the State are, however, subject to intensive biotic pressure on account of removal of forest produce, grazing and forest fires. The State, receiving precipitation only during monsoons and winter months, experiences 7-8 dry months every year making the forests highly vulnerable to fires. Even a small negligence during these dry months carries the risk of igniting forest fires that spread very fast riding on the wind. The damage caused to the forests by these fires has serious impact on the environmental, ecological and economic services forests provide. The forest field staff and the local communities need to maintain a strict vigil during the dry months to keep the forests safe from fires.

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### **INTRODUCTION**

Himachal Pradesh, nestled in the north-western Himalayas, literally means the 'land of snowy mountains'. The extensive and diverse forests in the State endow the landscape with immense natural beauty. The forests also perform very important ecological function of recharging the aquifers ensuring regular flow of water in the Yamuna, Sutlej, Beas, Ravi and Chenab river systems. The forests of Himachal Pradesh, in addition to their crucial role in environmental and ecological functions in the State and outside, provide for economic well-being of the local communities through various provisioning services. Continuous flow of environmental, ecological and economic services, thus, requires maintaining the integrity of the landscape.

The forests of the State are, however, subject to intensive biotic pressure on account of removal of forest produce, grazing and forest fires. The State, receiving precipitation only during monsoons and winter months, experiences 7-8 dry months every year making the forests highly vulnerable to fires. Even a small negligence during these dry months carries the risk of igniting forest fires that spread very fast riding on the wind. The damage caused to the forests by these fires has serious impact on the environmental, ecological and economic services forests provide. The forest field staff and the local communities need to maintain a strict vigil during the dry months to keep the forests safe from fires.

### **Forest Resource of Himachal Pradesh**

Forests are an important resource of Himachal Pradesh. The area classified as 'Forest' is 66.52% of the total geographical area of the State, of which large areas are alpine meadows or lie above the tree line, leaving an effective tree cover of 14,696 km.

**Table 1**

<b>Geographical Area of State</b>	<b>55,673 km2</b>	<b>100.00 %</b>
Forest Area (Legal)	37,033 km2	66.52%
Forest Cover	14,696 km2	26.40%
Area under Permanent Snow	16,376 km2	29.40%
Cultivable Forest Area	20,657 km2	37.10%
Area under PA Network	8,391 km2	15.07%

The State Forest Department is engaged in (a) bringing more area under forests through afforestation to increase the Forest cover in the State from the present 26.40% to 30% by 2030, and (b) to increase the density of forests through enrichment plantations in the existing forests.

The State's forests are characterized by the occurrence of various forest types varying from the Tropical Deciduous Forests to Subtropical Pine and Broad-leaved Forests, Temperate Forests, Sub-alpine Forests, and Alpine Forests. It is the diversity of its forests that makes the State a rich repository of biodiversity, yielding a variety of provisioning services to its people, which sustains their day-to-day household needs.

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**Forest Fires in the State and their Impact**

Forest fire is a recurrent annual phenomenon in the State. Even as all the forest types are potentially vulnerable to fires with even temperate forests experiencing ground fires if winters go dry, it is the Sub-tropical Pine 2Forests (Chir Forests) spread over 1258.85 km(3.4% of total forest area of the State) that experience the heaviest annual forest fires during the dry months of March to June. A glimpse of the extent of forest fires in the State over the last ten years can be had from the following table:

**Table 2**

Year	No. of Fire Cases Reported	Total Area Effected (in ha)	Estimated Loss (Rs.)
2008-09	572	6,586.12	60,05,064
2009-10	1906	24,849.52	255,22,928
2010-11	870	7,837.63	97,69,363
2011-12	168	1,758.15	43,07,878
2012-13	1798	20,773.97	276,82,589
2013-14	397	3,237.52	52,31,011
2014-15	725	6,726.40	113,26,522
2015-16	672	5,749.95	134,77,730
2016-17	1789	19,162.69	327,87,627
2017-18	670	4,586.47	55,11,091

The damage due to forest fires varies from just burning of leaf litter and dry grass in case of ground fires to extensive damage to the trees, biodiversity, and ecology in case the fires turn into crown fires. The forest fires also carry the risk of getting out of control and extending to habitations, posing danger to human life and property. The major damages caused by forest fires are listed below:

**Damage to the Forests**

The damage caused by fires to the forests is dependent upon the major tree crop of the forest and the time of fire. As a principle, broad leaf trees are more susceptible to fire damage than conifers, and in conifers Chir Pine is the most fire resistant species. The winter fires occurring in the high temperate forests are usually low fires burning the dry grass and leaf litter piled up due to leaves shed by deciduous trees. The summer fires occurring from March to June are more severe as this summer dry season coincides with shedding of needles by Chir Pine trees that are highly combustible. These fires, due to valley wind, spread very rapidly causing extensive damage to the forests. The Chir Pine trees per se are able to largely withstand these fires due to their thick bark and spring back to life as the monsoon arrives.

**Damage to Regeneration:** The forest fires, including the surface or ground fire, can cause extensive damage to the regeneration in the forests. In case of species having good coppicing power viz. Sal, the seedling coppices emerge. However, repeated burning reduces even the coppicing power.

**Impact on Productivity of the Forest:** Repeated forest fires have adverse impact on the productive capacity of a forest with the natural ecological succession getting a severe setback. The moist niches become dry and the moisture loving species like Oaks and Deodar tend to give way to species that can come up in dried situations. The repeatedly burnt forests get infested by exotic weeds smothering the regeneration of native species. The increment, crop density and the overall well-being of the forest is badly affected.

**Impact on Ecosystem Services:** The forests maintain the aquifers and help in continuous flow of water springs and streams. These also form a crucial source of provisioning in

the form of firewood, fodder and NTFPs for the communities. The capacity of the forests to sustainably provide these provisions gets adversely impacted by the fires.

**Effect on Protective Power of Forest:** Forest fires expose the soil to the hazards of erosive agencies such as wind and rain, and destroy organic matter which affects the soil structure. The protective functions of the forests, such as protection against accelerated erosion are, therefore, seriously affected due to repeated burning.

**Effect on Wild Life:** Forest fires also have adverse impact on the wildlife. Fires, in addition to deteriorating the habitat, cause direct damage to wildlife in the form of burning the eggs, killing the young ones and driving the adults from safe havens to outside forests making these vulnerable to poaching or getting killed by other animals.

**Adverse Impact on Aesthetic Function of Forests:** The forest fires, including the ground fires, leave the forests as burnt patches that remain sore points to the eyes and aesthetics for long. It impacts the recreational and scenic values of the forests

**Causes of Forest Fires**

The forest fires are caused either due to natural factors or due to human factors.

**Natural Causes**

The natural causes which start a forest fires include lightning or rubbing of dry bamboos with each other. In case of Himachal Pradesh, instances of forest fires on account of natural factors are very rare, with almost all fires attributable to human factors

**Human Causes**

Almost all forest fires in the State are attributable to human factors - unintentional or intentional.

**Unintentional Fires:** Such fires are caused due to carelessness on account of any of the following –

- Throwing of burning matchstick, live bidi/ cigarette stumps, or torch wood along the roads or in the forests, especially during dry seasons.
- Leaving the fires moldering in temporary hearths set up by graziers, labour, NTFP gatherers and travelers to cook food or to keep warm.
- Falling of glowing coal pieces from trains speeding through forests.
- Falling of dry pine needles or leaves on electric poles giving out sparks.
- Escape of fires to forests from burning of stubble in the fields or homestead, or burning of the grasslands adjacent to the forests.
- Accidental spread of fire in the forest while burning fire lines departmentally

**Intentional Fires:** Such forest fires are caused due to deliberate human actions on account of the following -

- Inducing new shoots of grass in summer by burning the dry grass.
- Destroying evidence of illicit felling by charring the stumps of illicitly felled trees.
- Inducing the gucchi growth by burning the undergrowth and grass.

- Making the collection of NTFP easy by burning the undergrowth and dry grass.
- Poaching/ trapping of wild animals.
- Scaring away wild animals from near villagers.

### **Components of Forest Fire**

Forest fires, like any other fire, are caused when the three essential components of the 'fire triangle' i.e. fuel, heat and oxygen, come together in right combination. The earth's atmosphere always has enough oxygen available to combine with the other two components (a fire needs air that contains at least 16% oxygen; the earth's atmosphere contains 21% oxygen). The forests, with multi layered vegetation, usually have good built up of leaf litter on account of some species drying up or shedding leaves and this leaf litter acts as ready fuel. This leaf litter is essential for decomposition into humus adding nutrients to the soil, helps in soil and moisture conservation and acts as habitat for micro flora and fauna.

With two components of the fire triangle i.e. 'oxygen' and 'fuel' naturally available, it is only the third component i.e. 'heat' that needs to be made available to ignite a forest fire. The general temperature in the State, even during summer months, rarely goes beyond 45C. As it requires temperature built up of more than 300C for woody biomass to burn, the forest fires cannot occur without some outside flame. With ample supply of oxygen and fuel already available, it is the temperature that is critical for sustaining a forest fire once it is ignited. In the case of Himachal Pradesh, the dry Chir Pine needles continue to fall from March till June and provide continuous fuel to sustain forest fires. The general relationship between fuel and temperature is simple: the more the fuel, the higher the heat; the more the heat, the faster the fire spreads. When there is plenty of heat and fuel, fires start at their own. It is said that the 'large fires live to feed themselves' as such fires can create their own winds and weather, increasing the flow of oxygen. A large fire can generate hurricane like situations with winds gaining a speed of up to 120 miles an hour.

The key to fire management is, therefore, understanding its nature- how it is created, what it takes to create fire, and more important during difficult fire seasons- what is to be done to control it?

### **Fuels for Forest Fire**

For forest fires to occur and sustain, a good supply of fuel is needed. The following form the important sources of fuel for forest fires in the State.

#### **Ground Fuels**

Ground fuel is made up of all the combustible material that lies below the loose litter on the forest floor. It includes various decayed stages of the humus, wood, shrubs and roots, and muck and peat. Ground fuel always supports the glowing combustion and not the flame. The ground fuel does not ignite till the moisture content drops very low (less than 20 percent). The combustion becomes very persistent once the ground fuels ignite.

#### **Surface Fuels**

All the combustible material on the forest floor forms surface fuel and is the most common type of fuel in the forests. The fallen tree leaves, dry grasses, weeds, ferns and other herbaceous plants, low brushwood, deadwood on the forest floor, logs and stumps, etc. form this type of fuel. In Himachal

Pradesh, the major fuel mass during winters is made by dry grass and fallen leaves and during dry summer months is made of falling Chir Pine needles. These fuels ignite very readily and provide the basic combustible material for the forest fires.

#### **Aerial Fuels**

The fallen branches of trees that get trapped in the under storey, dry standing trees, mosses, lichens and dry epiphytic or parasitic plants more than a metre above the ground constitute the aerial fuel. In Himachal Pradesh, the rills made on Chir Pine trees to extract resin also act as aerial fuel. The aerial fuels provide much needed combustible material for the spread of forest fire. The inferno in case of crown fires spreads by consuming aerial fuels.

Once the forest fire starts, the primary factor that helps in its spread is the continuity of fuel. Fuel continuity is also one of the most important factors in controlling forest fire. This is due to the fact that they transfer heat by radiation, conduction and convection. Continuity, a relative term denotes both the forms of continuity i.e. vertical and horizontal. These are very essential for the fire spread and are taken into account while planning forest fire control.

#### **Types of Forest Fires**

The following types of forest fires are generally come across:

1. **Creeping fire:** It is defined as a forest fire spreading slowly over the ground with low flame. Such a fire usually occurs in forest with practically no ground cover or undergrowth in summer night without any strong wind. Usually the ground is covered with a layer of dry leaves which burn slowly in the absence of strong wind
2. **Ground fire:** It is defined as a forest fire that burns the ground cover only including the carpet of herbaceous plants and low shrubs, which covers the soil. This type of forest fire consumes the organic materials of the forest floor and burns into the underlying soil itself. Such a fire sometimes occurs in deodar forests as a result of slash disposal, when it burns inside the humus for days without giving out flames and then causes a huge conflagration. That is why slash disposal in deodar forests is advised to be carried out after rains and before snowfall so that there may be no chance of ground fire shouldering inside humus
3. **Surface fire:** It is defined as a forest fire which burns not merely the ground cover but also undergrowth. Most of the forest fires in the plains are surface fires as they burn the groundcover as well as undergrowth.
4. **Crown Fire:** It is defined as a forest fire which spreads through the crown of tress and consumes all of part of the upper branches and foliage. This usually occurs in coniferous forests and the Chir Pine forests are most vulnerable to such fires. However, in the contest of Himachal Pradesh, such fires are very rare.

The above classes of fires are not exclusive, and independent of each other, i.e., once a fire of a particulars class starts it will not remain confined to that class. Usually one kind of fire may start and may develop into some other class or combination of two classes depending on the circumstances such as conditions of wind and undergrowth. For instance, in a forest with no undergrowth or ground cover, a fire may, to start with, be a creeping fire but after spreading over some area it may come across patches with ground cover as well as undergrowth. Here

it will turn into a surface fire. Similarly a fire in coniferous forests may start as a surface fire but with the help of lichens or dry climbers, it may reach the crown of a tree and then onwards, it may become a combination of surface and crown fire.

### **Protection from Fire Damage**

The measures towards protection from damages caused by forest fires can be grouped under two categories i.e. (a) Preventive measures, and (b) Remedial measures.

**Preventive Measures:** Preventive measures are those measures which help preventing the occurrence of fires or significantly reduce the chances of fire occurrence. Such measures can be further divided into:

#### **Public Oriented Measures**

- Since almost all forest fires in the State are caused by human action, participation of the general public and local communities in prevention and management of such fire is very crucial. Such measures usually involve –
- Building goodwill of the locals.
- Awareness and education of the masses.
- Restrictions on activities that can lead to forest fires.
- Putting in place reward/ punishment schemes

#### **Administrative and Technical Measures**

Forest fires occur mainly during dry season and the time of their onset can be fairly accurately estimated providing good opportunity to put in place various administrative and technical measures to prevent and manage forest fires. Some of these measures are –

- Forecasting the burning days based on meteorological data
- Putting in place fire control task teams.
- Reduction of fire hazard on the forest floor: Various actions can be taken for the reduction of fire hazards in the forests. These are—
- Keeping the camping sites clear of dried biomass.
- Keeping the roadsides clear of the inflammable material.
- Undertake early burning of inflammable material on forest floor at the beginning of the dry season to reduce the fire hazard load.
- Growing fire breaking green strips of fire hardy evergreen species in the forests.
- Clearing and Maintaining Fire Lines: Fire lines are strategically laid strips of pre-decided width in the forests that are kept clear of tree and undergrowth to prevent forest fires from crossing over from one part of the forest to the other and to provide access to the fire fighting teams. Fire lines are generally of two types –
- Internal Fire Lines: Such fire lines are 10-15 m wide strips laid inside the forest and act as barrier to spread of fire from one part of the forest to the other. In addition to these specially laid fire lines, streams, extraction or inspection paths, compartment boundaries, motor roads, etc. also serve as fire lines.
- External Fire Lines: Such fire lines are those which are maintained along the boundary or the periphery of the forest, so as to prevent escape of fire from non-forest areas outside a forest to the forests.

### **Remedial Measures**

These are the measures taken to control and extinguish fires, which break out despite the preventive measures. The following is the broad outline for such measures:

1. **Early Detection:** The earlier a fire is detected and reported, the less will be the damage done by it. Measures for early detection include deployment of fire watchers, and establishing fire observation posts at vantage points. The use of technology has come to help early detection of forest fires, and the satellite based information of forest fires forwarded to field units in the form of fire alerts through mobile apps is of good use.
2. **Quick Communication:** The early detection of forest fires needs to be followed up with immediate relay of information to the concerned field units. Wireless set have been the mainstay for relaying such information for long. With the mobile phone technology becoming available, fire alerts are now increasingly been sent through mobile apps.
3. **Early Action:** Quick action is needed for suppression of fires. The following must be ensured for this :-
  - Strategic locating of the fire-fighting squads, so that they may reach the affected area at a short notice.-
  - Keeping adequate manpower including forest staff, community volunteers ,and labour at fire camps; and keeping adequate provision of water, fire fighting tools, etc.

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